How Good are Present Gas Pump Measurements?

How much better will ATC be?

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Brief introduction with highlights of my career relating to ATC.

The cost-benefit analysis studies will need to accurately assess how well the present system of measuring gasoline is working.

You will also need to assess how much better the proposed solution will be. I'd like to briefly discuss both of those elements.

Let' start with how good are today's gas pumps? How does temperature affect gross gallon measurements?

Not Very Good based on Claims of "Hot Fuel" Rip-Off Story (Aug 2006)

- California
  - 75 F average tank temperature
  - 158 Million extra gallons sold
  - $509 Million extra made by retailers
- Minnesota
  - 53 F average tank temperature
  - 13 Million gallons lost
  - $37 Million lost by retailers

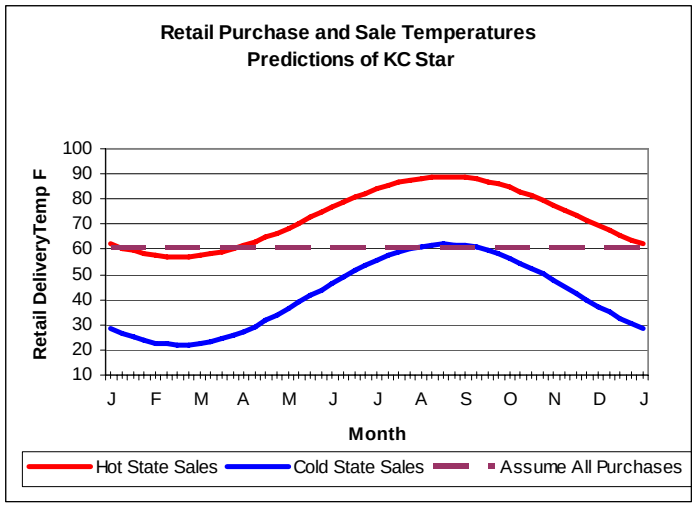
Also mention that Arizona and Florida averaged 82 F and Texas averaged 78 F and the Star posted some big consumer losses there as well.

Poor retailer that sells in MN, he's getting beat up pretty bad.

Averages are great for calculating big numbers but they rarely tell the whole story. Some times you have to look a little closer to see the real picture.

So let's look at what happens at one station in each state, for example one in the LA area and one in Central Minnesota.

“Hot Fuel” Rip-Off Model



Consequences of the hot fuel rip-off. The Star assumed stations took net gallons in 60 F and sold gross gallons out at ambient. Explain importance of 60 F line and integration as mathematicians would call it.

What happens to gasoline as temperature gets away from 60F?

Hot state (this case LA basin) actual data from CA website. Not so bad in Jan and Feb. But what happens as move to July and Aug. Every 10k load of gas results in 10.2 K sales. 200 gallons per load building up extra gal & $ in sales.

Cold State (northern MN) not so bad in July and Aug. But what happens in Jan and Feb. Every 10 K load of gas results in 9.8 K sales 200 gallons of gas literally missing from the tank.

How do we see the impact?

Follow the BOL (Bill of Lading)

	Gross	Temp F	API	Net
Hot (8/1)	8000	94	58	7816
Cold (2/1)	8000	26	62	8188

How do retailers actually use this information?

Bill of Lading is the official record of transfer of that fuel from supplier to retailer. Legal document subject to audit by tax, EPA, and FTC (W&M).

BOL tells nothing about price! What does it tell you, volume of product bought.

Look at Aug 1st purchase by a station in a hot state. They were buying gas both 7816 at 60F AND 8000 at the 94 F on the BOL.

In the cold state on Feb 15th they are buying their gas 8188 at 60 F and 8000 at 26 F on the BOL. Note different units of measures.

To verify the Star's model, we need to look at how BOL information plays out to both temperature curves, the product coming in and the product going out.

In NCWM survey, W&M taking hard look at actual temperature of product coming out of the nozzle, one step further than the Star. What we also need to know is the actual temperature of the fuel they purchase i.e. 60 F or ambient?

So how do retailers use the BOL information.

Star Assumption
MN Cold Purchase (2/1)

	Gross Actual	Gross Book	Gross G/L	
Start Inventory	2356	2356	0	
Inventory Purchase		8188		Net Purchase
Daily Sales		-7985		Gross Sales
End Inventory	2375	2559	**-184**	

Example of 1 load of fuel received

1. End of day last of month, stick tank and get volume from tank volume chart.
2. Take in new gross inventory purchase some time during the day, add to starting inventory
3. Close of day, sales totals from the pumps are summed, and subtracted from the total inventory.
4. Remaining book inventory in computed in the ledger
5. End of day, stick tank and get new volume from tank volume chart.
6. Compare actual inventory in the tank to the ledger to assess gains and losses.

Note that the tank chart is only a crude measurement and temperature impacts also affect the inventory balance.

Large loss exceeds the 40 gallon tolerance. One-half of 1 % (0.5%)

Star Assumption
Southern CA Hot Purchase (8/1)

	Gross Actual	Gross Book	Gross G/L	
Start Inventory	2356	2356	0	
Inventory Purchase		7816		Net Purchase
Daily Sales		-7985		Gross Sales
End Inventory	2375	2187	**+188**	

Mixed Units leads to large discrepancy!

188 gal gain exceeds 40 gal tolerance (0.5%)

I don't think this can really happen!

Remember this is happening to every single station in MN and CA. That's how you get to 158 million and 17 million gallons gained/lost.

Federal and State Auditors

- Auditors look for discrepancies between inventory purchased and inventory sold.
- Environmental – potential spills or system leaks.
- Tax - taxes on any unaccounted for fuel.
- Large discrepancies predicted by the Star's model would have been noticed!
- The truth is in the inventory records!

Actually many reasons this can't happen! Most important, too many people are watching for discrepancies in inventory

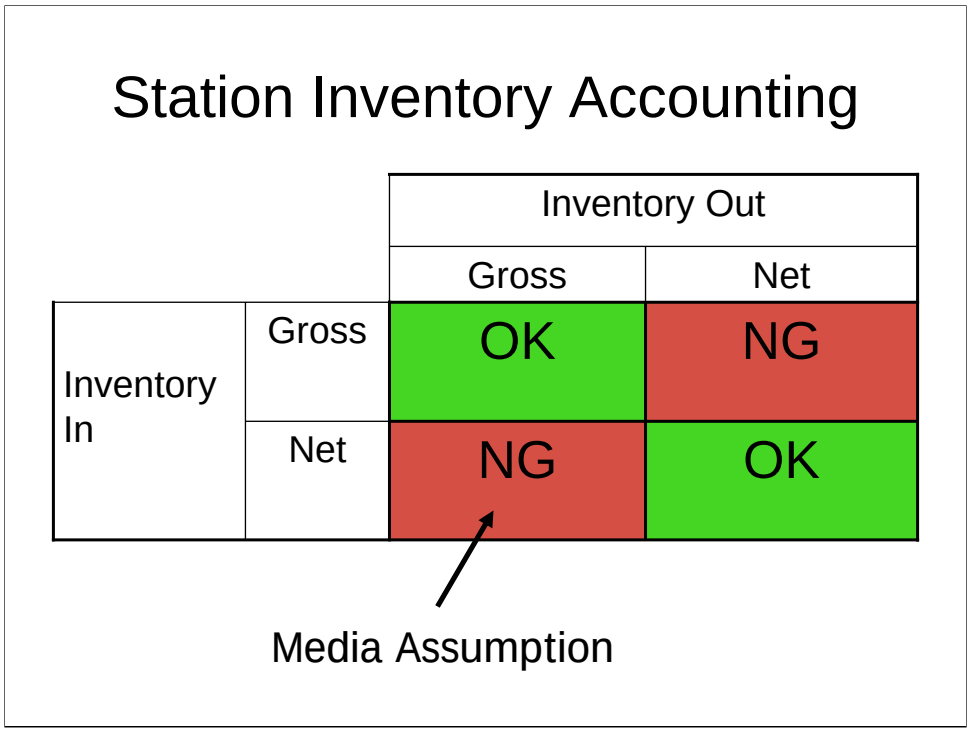
MN environmental folks would want verification that that missing 13 million gallons of gas is not in the ground polluting the water supply.

CA Tax and IRS would certainly want the taxes on those 158 million extra gallons if they actually existed.

The large discrepancies predicted by the Star would certainly have gotten notice because it affects every single station!

Even stations in 60 F states would see half a year with losses and half a year with gains.

Tax and EPA look at daily , weekly, monthly, and annual gains/losses. They aren't finding any significant gains or losses and we need to understand why.



They have only two legitimate choices (those allowed by Tax and EPA). My prediction for states 60 F average fuel temp and colder, primary accounting gross in gross out. That's how they are billed for purchases as well.

In fact The brochure "Doing Inventory Control Right for Underground Storage Tanks" on the EPA website directs stations to do inventory gross in gross out. EPA site also has references to automatic leak detection systems that do both net/net and gross/gross accounting

We are finding that hot areas may do both net in net out and gross in gross out for tax purposes. Haven't yet found one doing mixed units.

Star assumed that stations were taking inventory in in net and out in gross. That is mixing units of measure. You can't do that! I've been trying to explain this for last year. Yet this is what the Star is still predicting.

My Accountant advisor tells me that there is no business law or accounting rule against it, but suggests no one would do it because the station cannot realistically keep inventory in balance with mixed units accounting.

Gross In Gross Out Inventory (Cold)

	Actual Gross	Book Gross	Gain/Loss
Start Inventory	2356	2356	0
Inventory Purchase		8000	
Daily Sales		-7985	
End Inventory	2375	2371	+4

Example of 1 load of fuel received and simplified (e.g. no water issues). Looking for agreement within 40 gal (0.5% or one-half %)

MN all sales to retailers and all sales to customers in GROSS gallons

What are the temperatures? G in G out is 26 F in and ~ 26 F out. There are no mixed units here. Purchase not at 60 F! 8000 gallons was at 26 F. If they were buying at 60 they would have used 8188 from BOL

Net In Net Out Inventory (Hot)

	Gross in Gross out				Net in Net out		
	Gross Actual	Gross Book	Gross G/L	Temp	Net Actual	Net Book	Net G/L
Start Inventory	2356	2356	0	89	2308	2308	0
Inventory Purchase		8000		94		7816	
Daily Sales		-7985		91		-7812	
End Inventory	2375	2371	4	92	2322	2312	10

Assumed Temp of Sales

Still based on gross gallon measurements!

Example of 1 load of fuel, in hot states where it is customary to purchase in Net gallons Note: Retailers don't do this by hand, but use a tank monitoring system.

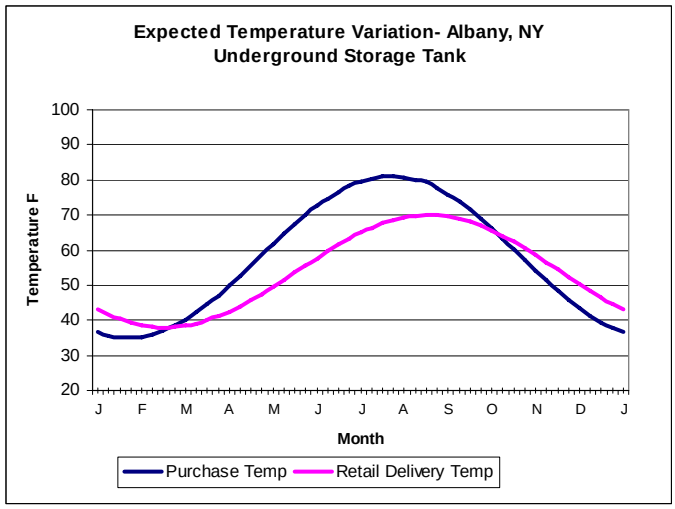
Critical fact, need gross numbers to do net in net out accounting. Starting inventory, purchases, sales and final inventory all start in gross gallons. Net gallons figures are all predictions.

We know that temp of fuel coming out the nozzle may be different from underground temp. net in net out accounting must use some approximation and mostly they use the underground temp at start of day .

Don't make too much of the difference net in net out vs gross in gross out. Since regardless of the choice, all measurements in accounting systems are based on GROSS gallons converted to Net.

What are the temperatures? G in G out is 94 in and 91 out. N in N out is 60 in and 60 out. There are no mixed units here and no big discrepancies.

More Accurate Model
Gross Gallon System

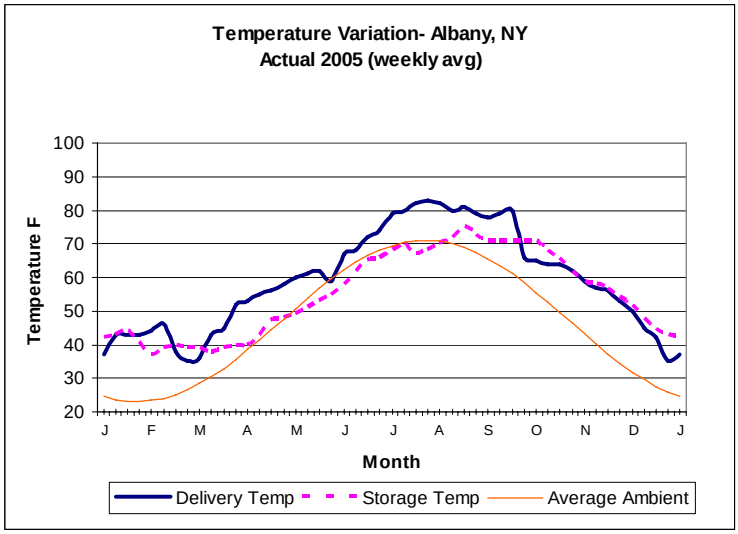


What do we know about temperature effects on 95% of the gas stations that use underground storage tanks.

1. Temperature of fuel coming into UST driven primarily from above ground tank storage. We know that these typically are warmer than average ambient temperature due to incoming product temperature and solar radiation heating of the product.
2. Temperature surrounding the underground tank is about 55 F all year round. New designs of underground tank are typically double wall and thus have insulating properties such that temperature losses to the ground are somewhat slow.
3. There is a lag between peak temperature in above ground and peak in below ground tanks that can reach 3 to 4 weeks depending on the area. This offset results in seasonal shifts in temperature differential, i.e. larger differentials spring/summer and smaller fall/winter.
4. NCWM survey having states gather temperature product in from BOL and measure temperature out at the nozzle. Note these are taken during normal work hours and may not fully represent all sale conditions (i.e. early morning, early evening, and night sales) Sept to Dec matched pretty good!
5. We measure true temperature effect by integrating between these two curves.

This is the real model for temperature. Where did this model come from?

Source of the Model



Shortly after first Star article, my retailers met with me and told me opposing facts. Like they lose in the summer and gain in the winter.

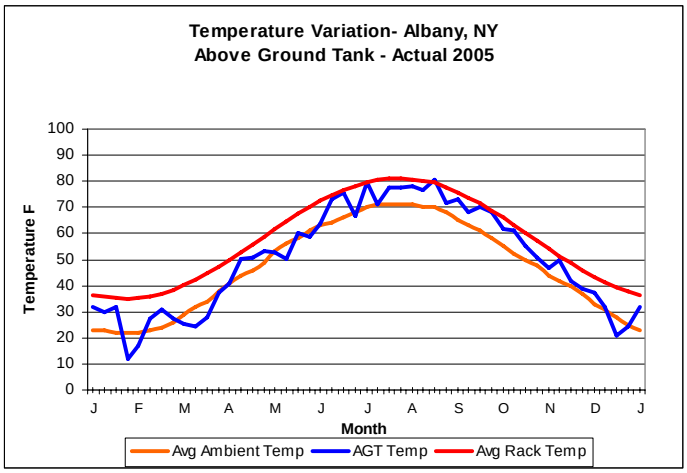
I found a highly reputable retailer that would let me look carefully at his records. He keeps gross in gross out and net in net out inventories. In addition he has both below ground tanks for gasoline and above ground tanks for kero and diesel.

Actual yearly temperature variations for calendar year 2005 comparing fuel purchase temperature from rack ticket to underground tank temperature.

Note how the underground tank reacts several weeks later. This plays out to make temperature work against the retailer.

We may need a slightly different model for above ground tanks.

Above Ground Tanks



Includes predicted Rack temperature and average ambient over AST temperature curve.

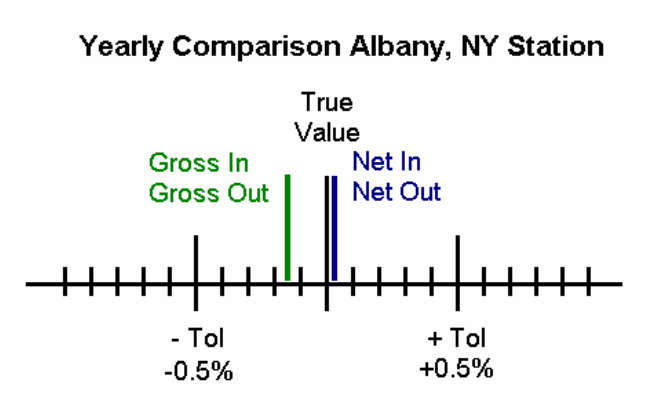
Important to note that this diesel tank gets delivery every 2-3 weeks unlike the underground gasoline tanks that get delivery 3 times a week.

Small volume (10k tank) more susceptible to daily temperature shifts than terminal tank and peaks may be following actual deliveries.

Annual Sales figures show that total sales 181267 for 181309 purchased (-0.02% annual loss with AST at this location)

Smaller losses than UST but still in favor of consumer.

Real World Expectations UST



Overall measurement, 99.85% accurate!
1,000,000 gross gal: Errors -1,500 gross / +300 Net

So what is the bottom line? How can we see the overall impact?

When you use same units accounting (gross in gross out or net in net out) you get pretty close agreement at the end of every day, week, month, etc. I have 5 years of data from one station and two from another.

Typical stations in NY saw small total annual loss in inventory. Have every reason to believe that situation is similar everywhere underground tanks are used. That product ended up in customer tanks.

Under the Star's assumption, we would have seen large daily discrepancies as the fuel temperature deviated over 7 F from 60 (1/2 of 1%). Very large inventory discrepancies at temperature extremes would be very obvious.

Under this model losses occur when Star predicted gains and vice versa.

This more accurate temperature model shows that retailers were always taking an annual loss due to temperature! Anecdotally this agrees with what retailers have claimed for three generations. Measuring 1 in3 in error on all pumps makes 4300 gallon difference.

But take note that total losses only 0.15%. There are also issues of variations and NCWM data will provide details. Most important to see that purchases for most customers are fairly regular throughout the year.

What about Price?

- Units conversion always corrects for price.
- Base Cost = total inventory cost / gross gallons available for sale
- Retailer must compete in the marketplace!
- W&M, FTC, EPA not entitled to see business costs. Tax may, only to verify taxes are paid!
- Customer not entitled to know what the seller's cost of inventory is! Or his markup!

Units net gallons and gross gallons are as different as gallons and liters and dollars and euros. When you properly convert them the price change automatically happens.

Base cost before addition of markup simple calculation.

Most important to understand that, with possible exception of price gouging in instances of disrupted supply, none of the regulatory agencies has any authority to regulate price that any retailer charges. If they measure correctly, including correct units conversion, they can charge whatever they want.

No retail customer gets to see the retailers costs.

Gross Invoice (8/1 purchase)

	Shipped gross	Price	Extended Price
Gasoline 87 Reg	8000	2.3432	18745.60
Discount Net 10 days	8000	-0.0234	-187.46
Hauling	8000	0.0288	230.40
Fed Excise Tax	8000	0.184	1472.00
Fed Oil Spill	8000	0.0012	9.60
Gross Receipts Tax	8000	0.164	1312.00
State Excise Tax	8000	0.0805	644.00
State Spill Tax	8000	0.00292	23.36
State Testing Fee	8000	0.0005	4.00
Prepaid Sales Tax	8000	0.14	1120.00
		Total	23373.50

NY taxes just for example with California Temperature. Gross gallons used for price extensions.

Net Invoice (8/1 purchase)

	Shipped Net	Price	Extended Price
Gasoline 87 Reg	7816	2.3984	18745.89
Discount Net 10 days	7816	-0.0239	-187.46
Hauling	7816	0.0295	230.57
Fed Excise Tax	7816	0.184	1438.14
Fed Oil Spill	7816	0.0012	9.38
Gross Receipts Tax	7816	0.164	1281.82
State Excise Tax	7816	0.0805	629.19
State Spill Tax	7816	0.00292	22.82
State Testing Fee	7816	0.0005	3.91
Prepaid Sales Tax	7816	0.14	1094.24
		Total	23268.51

Still 8000 gross for sales purposes

Note that the unit price discount and shipping changes because gas in the tanker and cost to ship is the same gross or net. $18789

Also note that the unit price column is not summed for you.

Main thing that changes is the tax component. Tax departments only require you to use consistent units in computing tax.

Differences

- Price of the fuel and shipping was $18789 net or gross except for $0.47 in rounding from converting net price to gross price
- Taxes paid on gross basis were higher since temperature was 94F (> 60F), i.e. $4584.96 gross vs $4479.51 net

Why Hot Fuel is Billed Net and Cold Fuel is Billed Gross?

- Legally minimizes tax burden, which is passed through to the retail customer!
- Where mean product delivery Temp < 60F, total gross gallons will be smaller taxable gallons on a yearly basis.
- Where mean product delivery Temp > 60F, total net gallons will be smaller taxable gallons on a yearly basis.

It's all about keeping the taxes at a minimum.

Interesting to note that consumer groups in Canada opposed ATC and correctly claimed that there would be a windfall in taxes.

I agree and in all states that presently bill on gross for the fuel and the taxes will probably see increased taxes with change to ATC.

Is this fair. One might suggest that MN and CA should pay same taxes, certainly at federal level. But consider that most of the 18.4 cents in federal tax goes back to states for interstate highway maintenance. That formula is based on taxable gallons sold.

At the state level, states have adjusted the tax rates to get them the revenue they want. May be politically dangerous to enact ATC and be perceived as raising gasoline taxes.

But that's not why we are here. We are looking at measurement.

Price Pass Through during Units Conversion

- Gallons/liters
  37,854 gross liter = 10,000 gross gal
  $0.793/liter = $3.000/gal
- Fuel & shipping, summer purchase - Hot
  $18789 = 7816 net x $2.4039
  $18789 = 8000 gross @ 94 F x $2.3486
- Fuel & shipping, winter purchase – Cold
  $19683 = 8188 net x $2.4039
  $19683 = 8000 gross @ 26 F x $2.4604
- SpragueEnergy.com – click [products] then [gross to net billing]

Every time you change measurement units you change the unit price by necessity.

SpragueEnergy.com

Gallons and liters

Net gallons and gross gallons

Also follows through for taxes.

Price Pass Through during Units Conversion Hot Purchase (Taxes)

	Net	Gross
Gallons	7816	8000
Total Cost of load of fuel	23269	23269
(1) $/gal total base cost	2.9771	2.9086
Total Cost fuel & shipping	18789	18789
(2) $/gal fuel/shipping	2.4039	2.3486
(1) - (2) Difference (Taxes)	0.5732	0.5600
$ Taxes Collected	$4480	$4480

Assumes transaction price extensions based on Net gallons, but pump sales will be in gross gallons.

Every time you change measurement units you change the unit price by necessity. Class action suit claimed that retailers made profit by collecting extra taxes on those gallons.

Unit prices are calculated by dividing total cost by units available for sale. Retailers divide 23269/8000 to find base price before markup.

Critical to see that correct units conversion also automatically corrects total taxes collected. No one was cheated and our tax auditors are satisfied.

How much can we improve?

- Can we recover ~1,500 lost gallons out of 1,000,000 gallons annual sales.
- Total value lost to the retailer $4,500 out of $3,000,000 in gross sales.
- Retail customers may have received that extra 1,500 gal as added value in some 60,000 individual purchases.

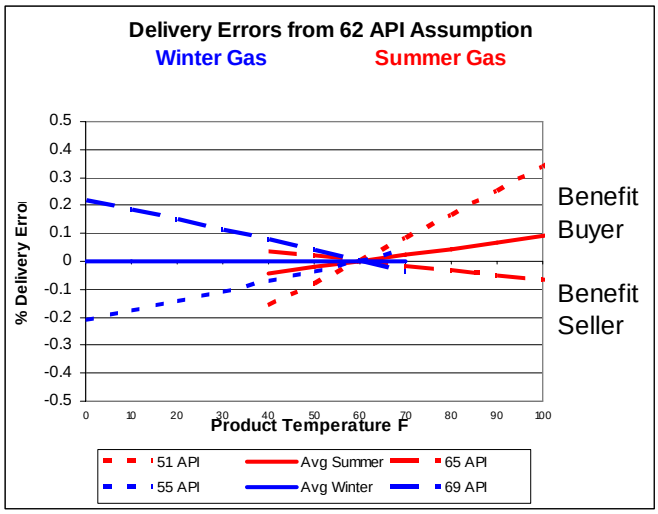
1. Who is harmed under this model?
   The retailer is harmed to the tune of 0.15% to 0.2 % with UST's Customers during fall and winter receive slightly less value (NCWM average 2 F) Customers during spring and summer receive slightly more value that more than offsets fall/winter losses.
2. Perspective +2 F (15 F = 1%)= +0.15% gain fall/winter ~$0.0045 price drop (price changes in 1 cent intervals) Estimated -7F = -0.46% loss spring/summer means ~$0.0138 price rise. These adjustments almost invisible due to the other price variations going on in the marketplace. Variation is still down in the noise. Typical retail price spread in a market area exceeds 20 cents.
3. Does it really pay to go after these losses now? Represents 1/3 cu in average calibration change. That is a good question! That's what these cost-benefit studies are for. However, interesting to note that retailers don't think so or they would be the ones asking to implement ATC to recoup their losses! Why would retailers choose to keep losing? Every retailer has shrinkage. They have pricing tools to recover those losses at relatively no cost!
4. What will retail customers get from upgrade to ATC? Another good question! Will they actually be able to see an improvement from on average 99.85% accurate to perhaps 99.95%. Will we be able to measure the improvement? Remember 1/3 cu in.

Obstacles

- Some of these losses may not be caused by temperature, e.g. losses from vaporization with Stage 1 vapor recovery or meter errors.
- Law of diminishing returns
- Law of unexpected consequences
- Basic inefficiencies in the ATC design

1. There are other possible sources of the losses, other than temperature. Dealers claim vapor recovery takes some of their product back to the terminal where it is subsequently recovered. Could this be 2-3 gallons in 10K 100 loads a year = 200-300 gallons? What about pump errors?
2. What is good for a 1 billion gallon a year refiner or a 100 million gallon a year distributor, may not be good for a 1 million a year or 500,000 a year retailer. As you get smaller you run into the law of diminishing returns. Eventually there is nothing left to gain. Refiner may have 10 meters, distributor 25 meters, all the retailers served have 1200 meters. Cost per meter essentially the same. Multiplier of 50: 0.4 cents/gal to compensate at wholesale and perhaps 2 cents/gal at retail.
3. The next thing you face is unexpected consequences. Here you make change with certain expectations but this change exacerbates the effects of other issues that result in little or no improvement. We are already talking about effects of temperature that are down in the noise.
4. We must go into this attempt to recover what's left of those 1,500 gallons a year with knowledge that our ATC device is only perhaps 90-95% efficient. The ATC device at the terminal uses the actual API gravity (product density) of the fuel. The retail ATC device uses an average value for density that will result in overcompensation of some fuels and under-compensation of others. In addition, it will fail to recognize that summer winter seasonal changes will introduce biases in the system.

Inefficiencies in ATC Design



Explain how fuels vary in density normally distributed about a mean for each season.

Each load received may have different density and result in overcompensation or under-compensation and gains or losses to the retailer.

Particularly important for hot states where you will be biasing the result in favor of the customer. In July & August at 90 F you will be forcing the retailer to give the customer about 0.06% more than actual.

Still biasing the system toward the retail customer.

A Delicate Balance
HB44 Fundamental Considerations

- 2.2. Theory of Tolerances - Tolerance values are so fixed that the permissible errors are sufficiently small that there is no serious injury to either the buyer or the seller of commodities, yet not so small as to make manufacturing or maintenance costs of equipment disproportionately high. ……

W&M serves to protect both buyer and seller but must consider the cost benefit of making tolerances (and performance requirements) more stringent. This is a delicate balance that evolves incrementally, driven by technology.

Commercial measurements do not seek perfection, but rather must be “good enough” to satisfy commercial needs without making the measurement costly, complicated, or delicate. Measurement accuracy improvement does not really enhance the value of the commodity!

I am only asking that you use an accurate temperature model in the cost-benefit analysis. I strongly suggest you verify whether the right one is the model I proposed or the Star’s. I don’t believe you will find even one station in this entire country mixing units as the Star has predicted. It just can’t work.

Crucial element, the evidence will confirm that retailers are the ones now being hurt by temperature, but they don’t believe its worth cost to fix. They can make market corrections (i.e. one penny price raise) to correct for shrinkage at no cost. We cannot ignore that ATC will cost someone $2-$3 Billion!

If we change, will we even be able to see the difference in measurement? Can we make an argument that the variations in fuel delivery temperature + and - cause anyone serious harm? NCWM temperature data will help us decide?

If my model correct and we verify that retailers are losing gallons, we are using public funds to help retailers decide if asset protection devices are good business!